ASTRONOMY AND ASTROPHYSICS

A European Journal

Volume 81 1980

Published by Springer International on behalf of the Board of Directors

Astronomy and Astrophysics A European Journal

Board of Directors

Chairman: G. Contopoulos (Greece)
H. G. Van Bueren (The Netherlands)
R. A. J. Coutrez (Belgique)
B. Hauck (Switzerland)
K. Hunger (Germany, Federal Republic)
G. Larson-Leander (Sweden)
W. Priester (Germany, Federal Republic)
A. Reiz (Denmark)
E. Schatzman (France)
G. Setti (Italy)
J. L. Steinberg (France)
L. Woltjer (ESO)

Editors-in-Chief

J. Lequeux
Observatoire de Meudon
92190 Meudon (France)
Tel. 534-75-30 ext 368

H. H. Voigt
Universitätssternwarte
Geismarlandstr. 11
3400 Göttingen
(Fed. Rep. of Germany)
Tel. (0551) 395052

Letter-Editor

S. R. Pottasch
Kapteyn Astronomical Institute
P. O. Box 800
Groningen 8002 (The Netherlands)
Tel. 050-116643

Editing Secretaries

Miss B. Perche
Mrs. M. Phung Ba

Mrs. U. Butkereit

Mrs. E. Goss

Board of Editors

K. Bahner (Heidelberg)
J. E. Baldwin (Cambridge)
B. Baschek (Heidelberg)
W. Becker (Basel)
E. J. Blum (Meudon)
K. H. Böhm (Seattle)
J. Borgman (Roden)
E. M. Burbidge (La Jolla)
O. J. Eggen (Woden)
W. Fricke (Heidelberg)
V. L. Ginzburg (Moscow)
M. Hénon (Nice)
J. T. Jefferies (Honolulu)
F. D. Kahn (Manchester)
F. J. Kerr (Maryland)
H. van der Laan (Leiden)
P. Ledoux (Liège)
P. O. Lindblad (Stockholm)
L. Mestel (Brighton)
P. G. Mezger (Bonn)
B. Morando (Paris)
F. Pacini (Firenze)
B. E. J. Pagel (Hailsham)
F. Praderie (Meudon)
M. S. Roberts (Green Bank)
M. Schmidt (Pasadena)
E. H. Schröter (Freiburg)
F. Spite (Meudon)
A. B. Underhill (Goddard Space Flight Center)
H. Van Regemorter (Meudon)
L. Woltjer (München/Garching)
J. P. Zahn (Nice)
Ya. B. Zeldovich (Moscow)
C. Zwaan (Utrecht)

The exclusive copyright © for all languages and countries, including the right for photomechanical and any other reproduction, also in microform, is vested in European Southern Observatory (ESO).
The use of registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Springer-Verlag · Berlin · Heidelberg · New York
Printed in Germany
Printers: Brühlsche Universitätsdruckerei, Gießen

Volume 81 1980

Contents

Stellar Structure and Evolution

Interpretation of New *BVR* Lightcurves of u Herculis
Provoost, P. 17

On the Evolutionary Status of the Optical Components of Massive X-ray Binaries
Savonije, G. J. 25

β Photometry of Przybylski's Star, A Comparison of Period Determination Methods
Weiss, W. W., Kreidl, T. J. 59

The Absolute Magnitude of the Hg-Mn Stars
Jaschek, M., Jaschek, C., Grenier, S., Gómez, A. E., Heck, A. 142

A *UBV* Light Curve of Nova Cygni 1978
Duerbeck, H. W., Rindermann, K., Seitter, W. C. 157

The Spectrum of Nova RT Serpentis (1909) in 1964, 1975 and 1978
Fried, J. W. 182

Measurements of Weak X-ray Sources by ANS
Brinkman, A. C., den Boggende, A. J. F., Heise, J., Mewe, R., Gronenschild, E. H. B. M., Schrijver, J., Parsignault, D., Grindlay, J. 185

The Effects of Binary Evolution on the Production of Heavy Elements in Massive Stars
Vanbeveren, D., Olson, G. L. 228

Stellar Collapse: Adiabatic Hydrodynamics and Shock Wave Propagation
Müller, E., Różyczka, M., Hillebrandt, W. 288

(LE) An Early-type Binary Model for SS433
van den Heuvel, E. P. J., Ostriker, J. P., Petterson, J. A. L7

(LE) Is the 1612 MHz Flare of U Orionis Related to Its Light Curve?
Garrigue, J. P., Mennessier, M. O. L13

(RN) Radii of Single Main Sequence Stars (AOV-G2V) Comparison with Radii Determined Using Binary Systems
Shallis, M. J., Blackwell, D. E. 336

Stellar Atmospheres

(LE) The Ultraviolet High-resolution Spectrum of Feige 86
Hack, M. L1

(LE) Pulsed High Energy Gamma Rays from Vela Pulsar
Bhat, P. N., Gupta, S. K., Ramana Murthy, P. V., Sreekantan, B. V., Tonwar, S. C., Viswanath, P. R. L3

Copernicus Observations of Neutral Helium Lines in Early-type Stars
Dufton, P. L., McKeith, C. D. 8

Type I Supernovae: IV. The Spectrum before the Maximum of Luminosity
Gordon, C. 43

Spectroscopic and Photometric Investigations of a Helium-rich Variable
Westin, B. A. M. 74

Roche Lobe Formation in Highly Eccentric X-ray Binary Systems
Haynes, R. F., Lerche, I., Wright, A. E. 83

Photometric and Magnetic Variability of the Late Ap Star HD 3980
Maitzen, H. M., Weiss, W. W., Wood, H. J. 323

Contribution to the Study of Composite Spectra Stars. I. New Organization for the Bright Stars Pattern of Hynek's Lists
Ginestet, N., Pedoussaut, A., Carquillat, J. M., Nadal, R. 333

(RN) UBV Photometry of V616 Mon (A0620-00)
Chevalier, C., Janot-Pacheco, E., Mauder, H., Ilovaisky, S. A. 368

Galactic Structure, Stellar Dynamics

Diffuse Gamma Rays and Galactic Hydrogen Distribution
Özel, M. E. 33

A Survey of High-latitude Regions at Balloon Ultraviolet Wavelengths
Laget, M. 37

White Dwarf Constraints on Mass Loss Rates and Models of Galactic Evolution
Koester, D., Weidemann, V. 145

How Far Do Bars Extend?
Contopoulos, G. 198

Kinematics of Planetary Nebulae. I.
Purgathofer, A., Perinotto, M. 215

The Number-intensity Relation for Galactic γ-ray Sources and the Emission from the Galactic Disk
Rothenflug, R., Caraveo, P. 218

The Force-field Normal to the Galactic Plane
House, F., Kilkenny, D. 251

(RN) A Radio Search for Planetary Nebulae near the Galactic Center II. Flux Density Distribution
Isaacman, R. 359

(RN) The Chemical Abundance Gradient in the Galaxy Derived from an Analysis of the H-R Diagrams of Open Clusters
Panagia, N., Tosi, M. 375

Interstellar Matter

An Abundance Gradient for Gaseous Magnesium in the Planetary Nebula NGC 7027
Péquignot, D., Stasińska, G. 121

Cyanoacetylene and Cyanodiacetylene in Interstellar Clouds
Walmsley, C. M., Winnewisser, G., Toelle, F. 245

(LE) A New Main Line OH Maser with a Probable Zeeman Pattern
Wouterloot, J. G. A., Habing, H. J., Herman, J. L11

Radio Polarization of the Vela X Supernova Remnant
Milne, D. K. 293

On the Rotation Measure and Turbulent Structure of the Vela Supernova Remnant
Lerche, I., Milne, D. K. 302

(RN) Three-dimensional Numerical Models of the Collapse of Turbulent Interstellar Clouds
Różyczka, M., Tscharnuter, W. M., Yorke, H. W. 347

(RN) Analytical Results for Interstellar Shocks
Elitzur, M. 351

(RN) On Heating by Ion Streams in H II/OH Regions
Elitzur, M. 354

(RN) Charge Transfer Reactions in Some Astrophysical Situations
Péquignot, D. 356

(RN) Faint Nebulosity near ω Centauri
Cannon, R. D. 379

Galaxies and Cosmology

Image Tube Spectrograms of NGC 5128 (Cen A)
Appenzeller, I., Möllenhoff, C. 54

On the Extragalactic Nature of the Far-ultraviolet Background
Jakobsen, P. 66

On the Multiple Explosion Picture of Extended Radio Galaxies
Nepveu, M. 78

Supercritical Disc Accretion on to Black Holes: Quasars and Type 1 Seyferts
Jones, B. C., Raine, D. J. 128

Accurate H I Profiles of Several Nearby Galaxies
Shostak, G. S., Allen, R. J. 167

High-resolution Profile of the [O III] Lines in NGC 1068
Pelat, D., Alloin, D. 172

A Correlation Between Isophotal Twisting and Flattening in Elliptical Galaxies
Galletta, G. 179

A Search for Broad Band H I Emission from Clusters of Galaxies
Shostak, G. S., Gilra, D. P., Noordam, J. E., Nieuwenhuijzen, H., de Graauw, T., Vermue, J. 223

Radio Continuum Observations of Markarian Galaxies at 1410, 2380, and 5000 MHz
Biermann, P., Clarke, J. N., Fricke, K. J., Pauliny-Toth, I. I. K., Schmidt, J., Witzel, A. 235

Continuum Observations at 2695 MHz in the Area of 3 C 27
Salter, C. J., Haslam, C. G. T. 240

Multifrequency Observations of Extended Radio Galaxies. I:3C 310
van Breugel, W. J. M. 265

Multifrequency Observations of Extended Radio Galaxies. II. B 0844+31
van Breugel, W. J. M. 275

Implications of Fine Scale Structure in Relaxed Double Radio Sources
Smith, M. D., Norman, C. A. 282

Radio Sources in the Vicinity of Bright Galaxies
Hummel, E. 316

Physical Conditions in the Compact Heads of Powerful Radio Sources
Gopal-Krishna 328

(RN) On Galaxy Masses Determined from H I Profiles
Casertano, S. P. R., Shostak, G. S. 371

The Sun

An Investigation of the Solar Na D Line Observations
Tomley, L. 95

The Physical Structure of Coronal Holes: Influence of Magnetic Fields and Coronal Heating
Pneuman, G. W. 161

(RN) Oscillator Strengths of Fe II Lines Derived from the Solar Spectrum: Choice of Solar Model Atmosphere
Blackwell, D. E., Shallis, M. J., Simmons, G. J. 340

Planetary Systems

High Spectral Resolution Observations of Jupiter between 30 and 50 μm
Baluteau, J. P., Marten, A., Moorwood, A. F. M., Anderegg, M., Biraud, Y., Coron, N., Gautier, D. 152

The Effects of Seeing on the Reflected Spectrum of Uranus and Neptune
Münch, G., Hippelein, H. 189

On the L_α Isophotes of Comet West (1976 VI)
Keller, H. U., Meier, R. R. 210

(RN) On the Acceleration of Cometary Plasma
Ip, W.-H. 260

Celestial Mechanics and Astrometry

Three-body Problem: The Existence of Families of Three-dimensional Periodic Orbits which Bifurcate from Planar Periodic Orbits
Ichtiaroglou, S., Michalodimitrakis, M. 30

Families of Vertical Critical Orbits of the Planar General Three-body Problem
Ichtiaroglou, S. 88

General Three-body Problem: Families of Three-dimensional Periodic Orbits (Part I)
Michalodimitrakis, M. 113

Long-period Effects in the Motion of Eighteen Trojan Asteroids and the Investigation of Special Problems of the 1/1 Resonance
Bien, R. 255

Physical Processes and Astrophysical Plasmas

Infrared Pumping of OH Main Lines
Bujarrabal, V., Destombes, J. L., Guibert, J., Marlière-Demuynck, C., Nguyen-Q-Rieu, Omont, A. 1

Collisional Broadening of Spectral Lines in Laboratory and Solar Spectra. I. The 6162, 6122, 6102 Å Multiplet of Neutral Calcium
O'Neill, J. A., Smith, G. 100

Collisional Broadening of Spectral Lines in Laboratory and Solar Spectra. II. Low Excitation Lines of Neutral Iron
O'Neill, J. A., Smith, G. 108

Proton Collisional Excitation in the Ground Configuration of Positive Ions in the $2p^2$ Isoelectronic Series
Faucher, P., Masnou-Seeuws, F., Prudhomme, M. 137

(RN) Observational Consequences of Positron Production by Evaporating Black Holes
Okeke, P. N., Rees, M. J. 263

On the Self-similar Solution for the Distribution Function of Particles Accelerated by Alfvén Waves
Lonngren, K. E., Axford, R. A. 363

(RN) Some Limits on Excitation Energies of Nuclei in Hot Matter
Mazurek, T. J., Brown, G. E. 382

Instruments and Data Processing

A Wavelength Calibration Device for Large Dispersion Spectrographs
Bruning, D. H. 50

Fast Evaluation of Fourier Series
Coffey, S., Deprit, A. 310

(RN) Accuracy of the Maximum Entropy Method
Strauss, F. M. 344

(RN) A Simple Procedure for the Reduction of Echelle Spectrograms
Spite, M. 365

Abstracts of Articles which will be Published in A. & A. Suppl. Ser. 39, No. 1

The Asteroids 118 Peitho and 952 Caia: Rotation Periods and Light Curves from Photoelectric Observations
Stanzel, R. (39, 3), *Schober, H. J.* (39, 3) 387

UBV Photoelectric Measurements of O-B Stars in SA 98
Lunel, M. (39, 7), *Garnier, R.* (39, 7) 387

Photometric Study of the Southern Open Cluster NGC 3532
Fernandez, J. A. (39, 11), *Salgado, C. W.* (39, 11) 387

More Wolf-rayet Stars in the Large Magellanic Cloud
Azzopardi, M. (39, 19), *Breysacher, J.* (39, 19) 387

Narrow-band Photometry of β Lyrae in 1971
Scarfe, C. D. (39, 23) 388

Photometry of V 436 Centauri During Superoutburst in May 1978
Semeniuk, I. (39, 29) 388

New Carbon Stars in Cygnus
Kurtanidze, O. M. (39, 35), *West, R. M.* (39, 35) 388

A Search for Faint Blue Stars in High Galactic Latitudes. II. Fourteen PSS Fields at Declinations + 6° and 0° near the South Galactic Pole
Berger, J. (39, 39), *Fringant, A.-M.* (39, 39) 388

Synthetic Spectrum of the Integrated Starlight Between 3000 and 10000 Å. Part I. Method of Calculation and Results
Mattila, K. (39, 53) 388

The Monochromatic Flux of 14 Southern Standard Stars from 3200 Å to 8800 Å
Tüg, H. (39, 67) 388

Two-colour Photoelectric Lightcurves and Elements of WW Dra
Mardirossian, F. (39, 73), *Mezzetti, M.* (39, 73), *Cester, B.* (39, 73), *Giuricin, G.* (39, 73) 388

Photoionization Models for Gaseous Nebulae: III. Third Period Elements
Köppen, J. (39, 77) 389

Elements Orbitaux de Quatorze Etoiles Doubles Visuelles
Baize, P. (39, 83) 389

Results of Observations Made with the Astrolabe of Santiago from 1972 to 1976
Noël, F. (39, 89) 389

A Catalogue of Emission Regions in M 33
Sabbadin, F. (39, 97), *Rafanelli, P.* (39, 97), *Bianchini, A.* (39, 97) 389

Photoelectric Observations of the Long-period Eclipsing System AZ Cassiopeiae
Tempesti, P. (39, 115) 389

An Instructive Case of Period Determination: The Eclipsing Spectroscopic Binary Star HR 9049 (HD 224113)
Burki, G. (39, 121), *Rufener, F.* (39, 121) 389

The Light Variations of the Ap Star HR 8861
Blanco, C. (39, 127), *Catalano, F. A.* (39, 127), *Strazzulla, G.* (39, 127) 389

Author-Index

Allen, R.J. 167
Alloin, D. 172
Anderegg, M. 152
Appenzeller, I. 54
Axford, R.A. 363
Azzopardi, M. 387

Baize, P. 389
Baluteau, J.P. 152
Berger, J. 388
Bhat, P.N. L3
Bianchini, A. 389
Bien, R. 255
Bierman, P. 235
Biraud, Y. 152
Blackwell, D.E. 336, 340
Blanco, C. 389
Breysacher, J. 387
Brinkman, A.C. 185
Brown, G.E. 382
Bruning, D.H. 50
Bujarrabal, V. 1
Burki, G. 389

Cannon, R.D. 379
Caraveo, P. 218
Carquillat, J.M. 333
Casertano, S.P.R. 371
Catalano, F.A. 389
Cester, B. 388
Chevalier, C. 368
Clarke, J.N. 235
Coffey, S. 310
Contopoulos, G. 198
Coron, N. 152

de Graauw, T. 223
den Boggende, A.J.F. 185
Deprit, A. 310
Destombes, J.L. 1
Duerbeck, H.W. 157
Dufton, P.L. 8

Elitzur, M. 351, 354

Faucher, P. 137
Fernandez, J.A. 387
Fricke, K.J. 235
Fried, J.W. 182
Fringant, A.-M. 388

Galletta, G. 179
Garnier, R. 387
Garrigue, J.P. L13
Gautier, D. 152
Gerassimenko, M. 286
Gilra, D.P. 223
Ginestet, N. 333
Giuricin, G. 388
Gómez, A.E. 142
Gopal-Krishna 328
Gordon, C. 43
Grenier, S. 142
Grindlay, J. 185
Gronenschild, E.H.B.M. 185
Guibert, J. 1
Gupta, S.K. L3

Habing, H.J. L11
Hack, M. L1
Haslam, C.G.T. 240
Haynes, R.F. 83
Heck, A. 142
Heise, J. 185
Herman, J. L11
Hillebrandt, W. 288
Hippelein, H. 189
House, F. 251
Hummel, E. 316

Ichtiaroglou, S. 30, 88
Ilovaisky, S.A. 368
Ip, W.-H. 260
Isaacman, R. 359

Jakobsen, P. 66
Janot-Pacheco, E. 368
Jaschek, C. 142
Jaschek, M. 142
Jones, B.C. 128

Keller, H.U. 210
Kilkenny, D. 251
Köppen, J. 389
Koester, D. 145
Kreidl, T.J. 59
Kundu, M.R. 286
Kurtanidze, O.M. 388

Laget, M. 37
Lerche, I. 83, 302
Lonngren, K.E. 363
Lunel, M. 387

Maitzen, H.M. 323
Mardirossian, F. 388
Marlière-Demuynck, C. 1
Marten, A. 152
Masnou-Seeuws, F. 137
Mattila, K. 388
Mauder, H. 368
Mazurek, T.J. 382
McKeith, C.D. 8
Meier, R.R. 210
Mennessier, M.O. L13
Mewe, R. 185
Mezzetti, M. 388
Michalodimitrakis, M. 30, 113
Milne, D.K. 293, 302
Möllenhoff, C. 54
Moorwood, A.F.M. 152
Müller, E. 288
Münch, G. 189

Nadal, R. 333
Nepveu, M. 78
Nguyen-Q-Rieu 1
Nieuwenhuijzen, H. 223
Noël, F. 389
Noordam, J.E. 223
Norman, C.A. 282

Özel, M.E. 33
Okeke, P.N. 263
Olson, G.L. 228
Omont, A. 1
O'Neill, J.A. 100, 108
Ostriker, J.P. L7

Panagia, N. 375
Parsignault, D. 185
Pauliny-Toth, I.I.K. 235
Pedoussaut, A. 333
Pelat, D. 172
Péquignot, D. 121, 356
Perinotto, M. 215
Petterson, J.A. L7
Pneuman, G.W. 161
Provoost, P. 17
Prudhomme, M. 137
Purgathofer, A. 215

Rafanelli, P. 389
Raine, D.J. 128
Ramana Murthy, P.V. L3
Rees, M.J. 263
Rindermann, K. 157
Rothenflug, R. 218
Różyczka, M. 288, 347
Rufener, F. 389

Sabbadin, F. 389
Salgado, C.W. 387
Salter, C.J. 240
Savonije, G.J. 25
Scarfe, C.D. 388
Schmahl, E.J. 286
Schmidt, J. 235
Schober, H.J. 387
Schrijver, J. 185
Seitter, W.C. 157
Semeniuk, I. 388
Shallis, M.J. 336, 340
Shostak, G.S. 167, 223, 371
Simmons, G.J. 340
Smith, G. 100, 108
Smith, M.D. 282
Spite, M. 365
Sreekantan, B.V. L3
Stanzel, R. 387
Stasińska, G. 121
Strauss, F.M. 344
Strazzulla, G. 389

Tempesti, P. 389
Toelle, F. 245
Tomley, L. 95
Tonwar, S.C. L3
Tosi, M. 375
Tscharnuter, W.M. 347
Tüg, H. 388

Vanbeveren, D. 228
van Breugel, W.J.M. 265, 275
van den Heuvel, E.P.J. L7
Vermue, J. 223
Viswanath, P.R. L3

Walmsley, C.M. 245
Weidemann, V. 145
Weiss, W.W. 59, 323
West, R.M. 388
Westin, B.A.M. 74
Winnewisser, G. 245
Witzel, A. 235
Wood, H.J. 323
Wouterloot, J.G.A. L11
Wright, A.E. 83

Yorke, H.W. 347